Managing Change in Manufacturing & Production Facilities

Change is all around us. As soon as a plant or processing facility is commissioned, employees and engineers begin to think of ways to make it better. Vendors develop new and improved products. Equipment needs to be bypassed or temporary repairs need to be made to reach the next turnaround. Leak-repair clamps are installed to stop environmental releases.

Changes like these will require updating procedures, modifying the existing equipment or adding new equipment. A robust management of change process can help prevent these improvements from creating problems ranging from off-spec product to catastrophic events.

Why Do We Need a Management of Change Process?

The incidents that occurred in 1974 at the Nypro UK plant in Flixborough and in 1984 at the Union Carbide plant in Bhopal, India, are examples of change gone terribly wrong.

At Flixborough, a 20-in. pipe was installed, bypassing a damaged reactor to allow the plant to operate while the reactor was repaired. Three months later, the temporary pipe failed releasing 30 tons of flammable cyclohexane. The ensuing vapor cloud explosion killed 28 workers, injured 89 workers and members of the public and destroyed the plant. The piping design and supports had not been reviewed by an engineer or technical authority prior to making the change, and risks associated with hydraulic surge in the piping during process upsets had not been fully addressed.

In the Bhopal incident, a runaway reaction resulted in the release of methylisocyanate (MIC). The MIC cloud left the plant and drifted over the neighboring town killing thousands and injuring tens of thousands. The effects of the MIC release are still felt in Bhopal today. A contributing factor in the incident was the temporary bypass of some plant safety systems. Risks associated with safety system bypass at the same time as a runaway reaction were not considered and properly managed.

As illustrated here, improperly managed risks can have serious and sometimes fatal consequences. Because of these incidents, other accidents in the U.S. and inconsistent change management practices in the chemical and refining industries, OSHA enacted the process safety management (PSM) regulation in the early 1990s. Two of the main components of the PSM regulation are management of change (MOC) and prestartup safety review (PSSR).

OSHA Management of Change Regulation

1910.119(1) Management of change. 1) The employer shall establish and implement written procedures to manage changes except for “replacements in kind”) to process chemicals, technology, equipment and procedures; and, changes to facilities that affect a covered process. 2) The procedures shall assure that the following considerations are addressed prior to any change:

(i) the technical basis for the proposed change;
(ii) impact of change on safety and health;
(iii) modifications to operating procedures;
(iv) necessary time period for the change; and
(v) authorization requirements for the proposed change.

3) Employees involved in operating a process and maintenance and contract employees whose job tasks will be affected by a change in the process shall be informed of, and trained in, the change prior to startup of the process or affected part of the process. 4) If a change covered by this paragraph results in a change in the operating procedures or practices required by paragraph (d) of this section, such information shall be updated accordingly. 5) If a change covered by this paragraph results in a change in the operating procedures or practices required by paragraph (f) of this section, such procedures or practices shall be updated accordingly.
THE OSHA PSM MOC ELEMENT & THE RELATIONSHIP TO SAFETY & OTHER PSM ELEMENTS

The OSHA PSM regulation’s intent is similar to most companies’ safety program—manage risk and ensure workers’ well-being. The MOC and PSSR portions of the PSM regulation do this by requiring change-related risks to be identified and assessed; appropriate authorization to be granted; changes to be communicated to affected workers; procedures and reference information to be updated accordingly; and a final review to be completed to ensure that the change is safe to operate.

MOC and PSSR are related to the process safety information, operating procedures, training, mechanical integrity and contractors PSM elements. MOC and PSSR help ensure that these elements are considered and addressed whenever a change is made to the PSM-covered process.

MOC PROCESS

The MOC process must address changes that range from minor changes to major capital projects as well as handling temporary and permanent changes. This can be accomplished in many ways. Some companies have developed “one-size-fits-all” MOC processes that are used for every change. Other companies find it easier to have multiple MOC systems. The multiple systems can be split based on the type of change (equipment vs. procedural), the duration (temporary vs. permanent) or the size of the change (minor vs. major). The decision to use an electronic MOC process or a paper process should also be considered. The important thing to remember is that the MOC process or processes should be flexible, easy to use and fit your plant culture.

A basic MOC process contains the following steps:

- initiation;
- preliminary review;
- risk assessment/technical review;
- approval to design/construct;
- design/construct/precommissioning;
- PSSR;
- approval to start up;
- follow-up activities.

In the initiation step, any employee should be able to propose a change to a procedure, equipment or technology of the PSM-covered process. The MOC forms should allow the initiator to document the what, why and when of the proposed change. The initiator then forwards the information to a member of the facility management team for review and approval.

The preliminary review consists of a “go/no go” decision based on the information supplied by the initiator. This may include discussions between the initiator and the reviewer to clarify the details of the proposed change and alignment with the facility’s needs. If the decision is made to proceed with the change, the preliminary reviewer should, as much as s/he is able, document the technical basis for the change, impact on safety and health and the timeframe to accomplish the change. If the change is temporary, the preliminary reviewer should also ensure that the date that the temporary change will be reverted to normal is included in the MOC documentation.

The risk assessment/technical review step is one of the most important activities within the MOC process. It is critical to involve the facility engineer, technical authority or someone with a deep understanding of the PSM-covered process in this step. The risk assessment should match the complexity of the change. For minor changes, it may be okay to ask the question “What if?” More complex changes require tools like process hazard analysis or failure mode-effect analysis. Some companies find it useful to include a risk assessment checklist in their MOC process. The checklist includes questions like “Does this change involve a shutdown or safety system?” and “Does this change increase or decrease the pressure, temperature or flow rates within the process?” The completed checklist can be the risk assessment or it can point the user toward a more sophisticated risk assessment tool or additional review by safety, environmental or technical experts. Regardless of the risk assessment method, it is important to document what could reasonably go wrong and the steps required to prevent it within the MOC prior to obtaining approval to design/construct.

OSHA PRESTARTUP SAFETY REVIEW REGULATION

1910.119(i)(i) Prestartup review. 1) The employer shall perform a prestartup safety review for new facilities and for modified facilities when the modification is significant enough to require a change in the process safety information. 2) The prestartup safety review shall confirm that prior to the introduction of highly hazardous chemicals to a process:

(i) Construction and equipment is in accordance with design specifications.

(ii) Safety, operating, maintenance and emergency procedures are in place and are adequate.

(iii) For new facilities, a process hazard analysis has been performed and recommendations have been resolved or implemented before startup; and modified facilities meet the requirements contained in management of change, paragraph (1).

(iv) Training of each employee involved in operating a process has been completed.
The approval to design/construct step is typically granted by the facility superintendent or manager. This person is committing resources toward completing the change and agreeing that the change can safely be made based on the information provided.

Most of the “real work” is accomplished in the design/construct/precommission step. In this step, final designs are completed, piping and equipment constructed, procedures updated, redline drawings created and equipment installation verified. If the design changes during this step, another round of risk assessment and approval is critical to ensure that risks associated with the new design are properly managed.

The PSSR step consists of the set of verifications and assurances that each portion of the work associated with the change has been properly completed. The PSSR items are typically assigned to multiple people, including facility engineers, operations leaders and maintenance leaders. A PSSR must include the following items:

- equipment meets the design specifications and has been properly installed;
- adequate safety, operating, maintenance and emergency procedures have been developed or existing procedures modified accordingly;
- process hazard analyses have been completed for new facilities and recommendations have been resolved or implemented before startup;
- employees involved in operating the PSM-covered process have been trained on or notified of the change as appropriate;
- safe work practices have been revised accordingly;
- process safety information used by employees (e.g., piping and instrumentation diagrams, equipment specifications) has been updated accordingly;
- items that will be needed in the future have been assigned for completion. This typically includes items like coordinating spare parts inventory with purchasing.

Once the PSSR is complete, the MOC is forwarded

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**Figure 3**

Sample MOC Review Checklist

<table>
<thead>
<tr>
<th>MOC Number</th>
<th>MOC</th>
<th>PSSR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Basis</td>
<td>Safety &amp; Health Impact</td>
<td>Risk Assessment/Technical Review</td>
</tr>
<tr>
<td>-------------</td>
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to the facility superintendent or manager for startup approval. By granting startup approval, the manager or superintendent is confirming that the requirements of MOC and PSSR have been completed properly and that the change is safe to start or to make active. Because of this, the superintendent or manager should have a solid, working understanding of the facility MOC process as well as the requirements of OSHA’s PSM standard.

As mentioned, follow-up activities need to be assigned to individuals for completion. The MOC process should be robust enough to ensure that these items are not forgotten as the next project or initiative moves to people’s inbox. Most companies will not close an MOC until the follow-up activities are completed.

**Improving the MOC Process**

The best way to ensure that the MOC process is working is to conduct periodic self-assessments or reviews. The review may be conducted by anyone with a solid understanding of the MOC process and should include a representative number of MOCs for the last 3 to 6 months. It is often better to have a person outside the department perform the review. This gives a level of independence to the review and helps find problems that someone inside the system may overlook. Many companies use a checklist or other guide to help obtain consistent results. The results can be used for individual coaching or to indicate areas of the MOC process that need to be improved.

**Common MOC Problem Areas & How to Avoid Them**

**Complexity**

Some MOC processes attempt to be a “one-size-fits-all” system. As a result, they are so complex that the users find it difficult to complete an MOC. This can lead to frustration and can also cause people to bypass the process for small changes because it is not worth the effort to run a small change through the system leading to some changes not being adequately managed. To help avoid this, consider having separate MOC processes that are specifically tailored for small changes or changes to procedures and documentation. Another method of handling this is to have a simple base MOC process that includes supplemental checklists or features that are only used when needed.

**Notification & Training of Affected Employees**

This is one of the gray areas of the PMS regulation. A facility is required to train and/or notify affected employees of the change, but there are no requirements to document the training or notification associated with the MOC. To avoid problems in this area, it is best to follow the “If you did not write it down, you did not do it” approach. Some plants have a binder in the control room or maintenance shop with copies of the MOC and rosters so that the employees can review and sign off. Others use electronic systems or e-mail to document the communication or training. Either method is fine as long as the facility ensures that employees returning from time off due to shift schedules, vacation, etc., review the MOC information on their first shift back to work.

**Startup Before Approval is Granted**

Occasionally, changes are made active prior to receiving startup approval. Reasons for this include emergency changes that need to be made during weekend or night shifts, superintendent or manager vacation or misunderstanding that another approval is needed before startup can occur. To handle changes when the approvers are not available, some facilities delegate approval authorization to facility operations leaders and shift leaders. Others have a rotating on-call process where other superintendents and managers approve another department’s MOCs. In the case of misunderstanding regarding the second approval for startup, well-written MOC procedures with clear expectations for each step are critical. Flowcharts and process maps can also be helpful.
Not Completing Follow-Up Activities

No magic bullet will ensure that follow-up activities are completed. Some companies use electronic systems that automatically send notices and generate tracking reports. Even these systems can fall short if the facility is not diligent in closing the loop and holding the assigned people accountable to complete the tasks. Periodic reviews, as described here, can also help identify when follow-up activities are not completed.

Temporary Changes That Last Forever

Pipe leak-repair clamps and bypass lines that have been around a long time are both examples of temporary changes that evolve into semipermanent and permanent changes. Some companies attempt to avoid this situation by setting limits for how long temporary changes can be in effect. MOC expiration dates of 120 to 180 days are typical. Other facilities conduct technical reviews and reauthorize temporary MOCs on a quarterly, semiannual or annual basis to ensure that the operating conditions have not changed and that the temporary change is still safe to operate and not becoming permanent. Like follow-up activities, diligence and periodic reviews are the best ways to prevent temporary changes from evolving into permanent changes.

Conclusion

The MOC process will help a facility meet the OSHA PSM regulations, but the benefits can reach beyond compliance. A simple, yet robust, MOC process can help ensure that risks associated with change are understood and properly managed, employees are trained on how the change affects them, accurate procedures are in place for maintenance and operations, equipment files are up to date and spare parts are available when they are needed. When these elements are in place, a facility can meet their goal of safe, reliable operations.

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